APPLICATION FOR THE UNITED STATES PATENT OFFICE

INVENTOR(S): James Douglas White and John Walter Zscheile, Jr.

TITLE: MULTI-BROADCAST BANDWIDTH CONTROL SYSTEM

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Northrop Grumman Corporation
Intellectual Property Department
90/110/CC
1840 Century Park East
Los Angeles, CA 90067-2199

MULTI-BROADCAST BANDWIDTH CONTROL SYSTEM

BACKGROUND OF THE INVENTION

1. Related Applications

This application is designed to make use of information supplied by ground stations as taught in our co-pending U.S. Application Serial No. 08/854,104 filed 11 May 2001 for a Dual Mode of Operation Multiple Access System for Data Link Communication which is incorporated by reference herein.

2. Field of the Invention

The present invention relates to communication networks of the type employed between airborne platforms and ground stations. More particularly, the present invention relates to a method and system for controlling the bandwidth of data transmitted by airborne transmitters to multiple ground station receivers.

3. Description of the Prior Art

Heretofore, point-to-point networks have been employed as intranets in businesses and as internets in the worldwide web. Point-to-point communications relate to a message or data sent to a particular receiver or user from a single source. When there are a number of receivers, the same message must be sent to each of the receivers which increases the bandwidth proportional to the number of receivers. U.S. Patents 6,038,216 and 6,046,980, and references cited therein, have suggested a method and system for managing bandwidth in point-to-point networks by assigning priorities to the type of data and to the individual receivers or users. There are no known systems or apparatus

for prioritizing messages and data in multi-broadcast or point-to-multipoint network systems.

It would be highly desirable to provide a method and a system for managing bandwidth in a point-to-multipoint central node airborne broadcasting system.

SUMMARY OF THE INVENTION

It is a primary object of the present invention to provide a system and method for managing bandwidth in User Datagram Protocol (UDP) systems.

It is a primary object of the present invention to provide a system and method for simultaneously managing bandwidth in both point-to-point and point-to-multipoint broadcast networking systems.

It is a principal object of the present invention to provide a system and method for simultaneously managing bandwidth in Transmission Control Protocol (TCP) and UDP systems.

It is a primary object of the present invention to provide a system and method for converting TCP data to UDP data.

It is a primary object of the present invention to provide a dedicated controller or personal computer (PC) for reading fields of a TCP header and determining whether or not it will be converted into a UDP format data and header.

It is a principal object of the present invention to provide a dedicated controller or PC for assimilating data from a plurality of TCP headers and converting the TCP data into UDP headers and data for multipoint broadcasting of data.

It is a primary object of the present invention to provide a method and system for broadcasting TCP headers and data and UDP headers and data randomly intersperced.

According to these and other objects of the present invention there is provided a communications network between an airborne platform and a plurality of ground stations (or a central node and a plurality of internet stations or nodes). A bandwidth flow control system is interposed between the stations and the central hub or platform which manages flow bandwidth of data in both TCP and UDP format simultaneously.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a table showing the seven protocol layers or levels of information used in Open Systems Interface (OSI) standard protocols;

Figure 2 is a schematic representation or arrangement of data in an Internet Protocol Header (IP Header) layer shown in Figure 1;

Figure 3 is a schematic representation of a UDP Header which resides in the data field of the IP Header;

Figure 4 is a schematic representation of a TCP Header which resides in the data field of the IP Header; and

Figure 5 is a block diagram of the preferred embodiment of the present invention showing a computer in a central hub or airborne station connected to both a conventional internet network and to an airborne communications network.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Before referring to a detailed description, the applicants will use in this application the terms central node or central hub to mean any transmitting station that transmits to and receives from a plurality of stations various types of data. Thus, typical systems that would be employed in the present invention would be a system on the internet, a segment of the internet and/or a military air-borne platform that disseminates surveillance data over wireless communication means to a plurality of ground stations.

Refer now to Figure 1 showing a table 10 having seven layers of protocol information as used in an OSI standard protocol system. The purpose of the OSI layers and the different layers within the OSI protocol is to provide a set of services at each of the layers which allows the layers to communicate with each other and allows computers or other devices to communicate with each other. The known layers are numbered L1 to L7.

Refer now to Figure 2 showing a schematic representation of the arrangement of data in the L3 network layer (IP Header) layer shown in Figure 1. The IP Header format 12 is shown comprising rows of 32 bits numbered 0 to 31. The first five of the rows comprises 20 bytes and form the IP Header as part of the total length of the IP Header format. The field 13 is used to identify the version of IP Header being used. The field 14 is used to identify the number of 32 bit rows in the IP Header format. The field 15 is used to identify the type of service which was formerly a quality of service (QoS) and is now used for various uses. The field 16 is employed to denote the total

length of the complete IP Header format as shown in the right margin. Since the data field 18 may comprise a variable number of rows R7 to RX, the total length of the IP Header format is needed. The only other field of importance to this invention is the field 11 which is used to designate the destination IP address. The remaining fields which have not been specifically discussed are standards fields and are found in textbooks and do not require additional explanation herein.

Refer now to Figure 3 showing a schematic representation of a UPD Header format which comprises two rows of 32 bits each comprising eight bytes and a data field which may comprise a variable length of data as will now be explained. The UPD Header format 20 is shown comprising a source port number field 19 and a destination port number field 21. In order to identify the length of data there is a field 22 which defines the total number of bytes in the header and data field 24. A 16 bit check sum is provided in field 23.

Refer now to Figure 4 showing a schematic representation of a TCP Header format which resides in the data field 18 of the IP Header. The TCP Header format 25 is shown having a field 19′ which identifies the sender port number similar to that described in Figure 3. The field 21′ defines the destination port number of the receiver and is similar to the field 21 in Figure 3. The 32 bit sequence number 26 identifies the first sequence number for the data being sent in this particular TCP Header. The remaining fields of the TCP Header format shown in Figure 4 are standard and are well known in this industry and do not require a detailed description.

Refer now to Figure 5 showing a block diagram of the preferred embodiment of the present invention system 27 comprising a central hub or airborne platform computer 28 connected to a conventional internet network and also connected in a broadcast configuration showing an airborne communications network. The central processing unit 28 is shown having protocol levels L1 and L2 at the ethernet level, having level L3 at the internet protocol level and having a transport control protocol level L4 at the transport level as described hereinbefore with reference to Figure 1. The information formatted at the ethernet level is outputted as a TCP protocol data format package on line 29 and is inputted to a flow control system 31. In the preferred embodiment of the present invention, the flow control system has been implemented in Packeteer(TM) software similar to QoS software packages provided by such firms as Cisco, Starburst, Sitara and Checkpoint Systems. The TCP data on line 29 also appears at the output of the flow control system on line 32 and is input into the PC or controller 33 at the TCP input port. The PC or controller 33 is shown comprising a logic portion 34 and a memory portion 35. The memory and logic of the controller 33 determines by examining the flag data in the TCP format header whether or not the data should be converted to UDP format or should continue its journey in its TCP format at the output port 33P.

The UDP or TCP data and its header is coupled to a transmitter/receiver 36 which is provided with an antenna 37. The information is broadcast to a plurality of ground stations 39 each comprising a transmitter/receiver and an antenna 38. The ground stations 39 are capable of deter-

mining their maximum rate of data input or reception and may transmit this information from antenna 38 to antenna 37 which in turn is transmitted via line 43 to the CPU 28. The CPU 28 uses this information to reprogram the flow control system 31 via line 45.

In a similar manner, the system described hereinbefore also may operate on an internet or a LAN or a WAN. In this event, the output information from port 33P is supplied to the interface 41 which may be an internet interface and to line 42 which may be a local area network (LAN) line or wide area network (WAN) line 42. The information on the network 42 is supplied to the plurality of stations 39′ or to individual stations as the case may be if it is a point-to-point network system. Similarly, the plural stations 39′ may transmit on network 42 to the interface 41 their ability to receive information from the computer 28 and this information is supplied via line 44 as shown.

Having explained the preferred embodiment system Figure 5 and an equivalent alternative system in the same drawing, it will be appreciated that both systems may not be operated together at the same time because one is airborne and the other one is basically a ground system. However, the computer or controller 33 which performs the conversion of TCP input data to UDP input data is the same and may be explained as follows with reference to Figures 3 and 4. In Figure 4 there is shown a field number 21′ for the destination port number. When a predetermined number appears in the field 21′ of the TCP header the controller knows that the data in this header should be converted into a UDP header format. This predetermined number is also used by the controller 33 to modify the destination IP ad-

dress 11 of IP header format 12 into a network destination IP address or a subnet destination IP address which may be read by all ground stations or a subset of the ground stations, respectively. The information shown in Figure 4 is transferable directly from fields 19′, and 21′ directly into fields 19 and 21. The controller 23 has to calculate the other fields and insert them in the proper place in the UDP header format. It will be understood that the data field 24 in the UPD header is usually much larger than the data field 24′ in the TCP header. To overcome this problem, the length of the field is sent over first and as subsequent TCP headers arrive they are assimilated and sent over to complete a UDP header. Stated differently, a plurality of TCP headers may be employed to generate one UPD header.

Having explained a preferred embodiment of using a portion of the field 21 to flag or designate a TCP header for conversion to a UDP header, it will be understood and appreciated that the same flag or a similar flag could have been inserted in the data field 24′ and accomplish the same results. The fact that the field can vary from one of the fields 21 to one of the other unnumbered fields does not affect the result achieved by the controller 33.

A typical example of the utility of the present invention is a system which employs in an airborne platform the computer 28 which has assimilated from numerous other sources surveillance radar images, moving target indicator (MTI) images and all types of data which accompanies this information in textual form. As many as a thousand ground stations may be able to implement this information. However, it would be impossible to take particular information

and send it by a point-to-point communication mode to each of the receiving stations and have sufficient bandwidth to disseminate the information in a reasonable length of time in which it could be utilized. In order to overcome this problem, the present invention not only prioritizes the information which is assimilated in point-to-point information format, but converts the information which may be disseminated in a point-to-multipoint format so that many or virtually all of the receiving stations may receive the most important information simultaneously and from time to time individual stations may receive point-to-point information which is not needed or should not be disseminated to all of the ground stations.

Another example which is yet to be implemented is a food chain or department store or retail store that has a large number of outlets and desires to change the prices on a number of individual items throughout all of the outlets. Thus, the outlets will be treated as the ground stations and the central hub is the central headquarters CPU which disseminates the information to the retail outlets. The present system will allow the headquarters store to simultaneously change the price in the computers of the ground stations or outlets by equating a new price to the bar code scanned without changing the marked designated price on counter or display unit.

Another example is a corporation or other entity that desires to send out meeting notices to all required attendees. The computer 28 can program the TCP data so that it is converted to UDP data and disseminated to the desired plural stations 39′ simultaneously.

Since CPU 28 has updated information from its ground stations, it can dynamically change or prioritize the transmission of types of data to the individual stations in a point-to-multipoint mode.

Having explained a preferred embodiment in which the IP destination address 11 and TCP formatted data may be converted to network destination IP addresses and UDP formatted data, respectively, it will be understood that other formats and fields may be employed to accomplish the same desired result.